

**United States District Court
EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION**

STMICROELECTRONICS, INC.

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V.

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SANDISK CORPORATION

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CASE NO. 4:05CV44
(Judge Schell/Judge Bush)

**REPORT AND RECOMMENDATION
OF UNITED STATES MAGISTRATE JUDGE**

Shortly before expiration of its patent, STMicroelectronics, Inc. (“STM”) filed suit against Sandisk Corporation (“Sandisk”) for patent infringement. Sandisk has filed a Motion for Summary Judgment of Noninfringement, or in the Alternative, Invalidity of Claims 1 and 2 of U.S. Patent No. 4,592,802 (Docket #127). After considering the motion, responses, and summary judgment evidence, the Court finds that the motion should be granted on the ground of noninfringement.

Standard

Summary judgment is proper where there are no genuine issues of material fact regarding the question at hand. *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1569 (Fed. Cir. 1997); *see also* Fed. R. Civ. P. 56(c). Summary judgment of non-infringement, as well as invalidity, is appropriate in patent cases. *See, e.g., KCJ Corp. v. Kinetic Concepts Inc.*, 223 F.3d 1351, 1360 (Fed. Cir. 2000) (affirming summary judgment of non-infringement); *Ishida Co., Ltd. v. Taylor*, 221 F.3d 1310 (Fed. Cir. 2000) (same); *Bayer AG v. Elan Pharmaceutical Research Corp.*, 212 F.3d 1241 (Fed. Cir. 2000) (same); *Kemco Sales Inc. v. Control Papers Co.*, 208 F.3d 1352 (Fed. Cir. 2000) (same); *U.S. Gypsum Co. v. Nat’l Gypsum Co.*, 74 F.3d 1209, 1212 (Fed. Cir. 1996); *see also, PetroliteCorp. v. Baker Hughes Inc.*, 96 F.3d 1423 (Fed. Cir. 1996) (summary judgment of invalidity due to prior sale

and public use); *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1568 (Fed. Cir. 1988) (summary judgment of invalidity due to prior publication and prior sale).

As the moving party, SanDisk has the initial burden of demonstrating the absence of a genuine issue of material fact. *See Celotex Corp. v. Catrett*, 477 U.S. 317, 323 (1986); *see also* Fed. R. Civ. P. 56(c). There is no genuine issue of material fact “where the record taken as a whole could not lead a rational trier of fact to find for the non-moving party.” *Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.*, 475 U.S. 574, 587 (1986). Once SanDisk has shown that there are no genuine issues of material fact, the non-movant, ST, must “set forth specific facts showing that there is a genuine issue for trial” to avoid summary judgment. FED. R. CIV. P. 56(e). In doing so, ST “must do more than present some evidence on an issue it asserts is disputed.” *Avia Group Int’l v. L.A. Gear Cal., Inc.*, 853 F.2d 1557, 1560 (Fed. Cir. 1988). “The mere existence of a scintilla of evidence in support of the [non-movant’s] position will be insufficient; there must be evidence on which the jury could reasonably find for the [non-movant].” *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 252 (1986).

Patent infringement involves a two-step analysis. First, the court must construe the meaning of disputed claim terms. *See Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995). Second, the construed claims are compared to the allegedly infringing method or device. *See Id.* In this case, the Court has already construed claims 1 and 2 of the '802 patent.

To establish infringement, the patentee bears the burden of demonstrating that each and every limitation set forth in the claims is found in the accused method or apparatus either literally or under the doctrine of equivalents. *See Carroll Touch, Inc. v. Electro Mech. Sys., Inc.*, 15 F.3d 1573, 1578-79 (Fed. Cir. 1993). Generally, a claim is literally infringed when an accused method literally

embodies each limitation of the claim. *Draft Foods, Inc. v. Int'l Trading Co.*, 203 F.3d 1362, 1370 (Fed. Cir. 2000). Each limitation or element in a claim is considered material and essential. *See Lemelson v. United States*, 752 F.2d 1538, 1551 (Fed. Cir. 1985). If the accused device or method lacks even a single limitation of the patent claim, literal infringement cannot be found. *See id.*

If there is no literal infringement, infringement may still be found under the doctrine of equivalents. *See Warner-Jenkinson Co. v. Hilton-Davis Chem. Co.*, 520 U.S. 17, 19-20 (1997). Infringement under the doctrine of equivalents arises when there is "equivalence" between elements in the accused product or process and elements of the asserted claims. Equivalence is said to exist where an element of the accused product or process performs substantially the same function, in substantially the same way, to obtain substantially the same result as the element literally found in the claim. This has been called the function-way-result analysis. *Id.* at 40. Determining infringement under the doctrine of equivalents, moreover, requires an objective inquiry on an "element-by-element basis." *Id.* In other words, an equivalent refers to the equivalency of an element with one that is substituted in the accused product. *See id.* at 29. But "there can be no infringement as a matter of law if a claim limitation is totally missing from the accused device." *London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1539 (Fed. Cir. 1991); *see also Laitram Corp. v. Rexnord, Inc.*, 939 F.2d 1533, 1535, 1539 (Fed. Cir. 1991).

Analysis

U.S. Patent No. 4,592,802 (the "802 patent") describes a method of fabrication of aluminum contacts through a thick insulating layer in an integrated circuit ("IC"). The background for the invention notes that it is a common practice in the fabrication of IC's to make use of an interconnecting layer of aluminum for connecting the different elements of the IC to each other. The

former process for fabrication could lead to results in increased pitch between conductors or openings having sharp edges resulting in fractures of the aluminum at the time of deposition by vacuum evaporation. The '802 patent proposes a solution which guards against the danger of fracture of the aluminum while also avoiding any increase in the pitch between conductors, or even makes it possible to reduce the pitch.

Figure 3 of the '802 patent demonstrates that an insulating layer has been deposited on a layer of substrate. The insulating layer is deposited in a single operation. The purpose of the insulating layer is to serve as support for the interconnecting layer. A contact opening is then cut into the insulating layer, *preferably by vertical anisotropic etching*.

Once this process is completed, Figure 4 demonstrates the next step. A conductive layer having high covering power on both *vertical and horizontal* surfaces is deposited by chemical decomposition in gas phase. The deposition is performed to a sufficient depth to ensure that the entire volume of the narrow contact opening is filled with conductive material and to ensure that the thickness of the material opposite to the opening is distinctively greater than the thickness above the insulating layer.

After this step is completed, the material is etched by *vertical anisotropic etching* to a uniform depth corresponding substantially to the thickness deposited over the entire surface of the insulating layer, so as to remove the conductive material outside the opening while removing only a small portion of the conductive material in the opening. (See Fig. 5).

The next step is to deposit an interconnection metal and finish with etching so as to define the desired interconnection pattern. (Figs. 6 and 7). In simple terms, the process involves laying an insulating layer, cutting a contact opening in the layer, depositing a conductive layer within the

contact opening and on top of the insulating layer, etching the conductive layer to remove the conductive material on top of the insulating layer and removing a small portion from the contact opening, then depositing an interconnection metal on top of the insulating layer as well as the contact opening and performing the desired etching. Claims 1 and 2 are identical, except Claim 2 calls for the conductive material to be polychrystalline silicon or tungsten or molybdenum or titanium. The third and last claim is a dependent claim.

Neither side disputes that the Tower and UMC processes use chemical mechanical polishing (“CMP”), which is also called chemical mechanical planarization. The Court is limited to the evidence before it. From the volumes of evidence submitted, the Court must determine whether there is a fact issue that CMP is actually vertical anisotropic etching, and if so, whether the process practiced infringes. At an oral hearing on certain issues, the parties agreed that if CMP is not vertical anisotropic etching, then there is no literal infringement.

Dr. Duane Boning is Sandisk’s expert witness. He is a Professor of Electrical Engineering at M.I.T. His research focuses on understanding and modeling of CMP. It is his opinion that not all limitations of Claim 1 (and 2) are found, either literally or under the doctrine of equivalents, in the accused Tower and UMC processes.

The Presence of Voids

Boning claims that the patent requires that there be no voids in the contact opening where the conductive material is deposited. He disagrees with STM’s expert, Gwozdz, that voids are inconsequential. As Boning points out, Claim 1 requires that conductive material be performed to a sufficient depth to ensure the entire volume of the narrow contact opening is filled with conductive material. The material must have a high covering power on both the vertical and horizontal substrate

surfaces. Therefore, he disagrees with Gwozdz's statement that nothing in Claims 1 or 2 excludes a process that produces seams and voids. Boning claims that voids are unwanted, avoidable, and antithetical to the teaching and claims of the '802 patent. Boning claims that the Tower and UMC processes do not insure that the entire volume of the narrow contact opening is filled, which does produce voids. Boning also points out that some fabrication using Titanium ("Ti") and or Titanium nitride ("TiN") in the contact openings is deposited using techniques other than deposition by chemical decomposition in gas phase. According to Boning, Ti and TiN are deposited in the contact opening by a process he does not define, but refers to as a barrier layer, and then the remainder of the contact opening is filled by chemical decomposition in a gas phase. Thus, there is a two-step process using different processes in filling the contact opening which is not the same method as taught by the '802 patent; *i.e.* one process

Whether Chemical Mechanical Polishing is Vertical Anisotropic Etching.

In the claims construction, the Court ruled that etching is defined as removing material. Boning's position is that the process used by Tower and UMC is chemical-mechanical polishing. He explains that this is a method for removing elevated portions of the exposed surface of a wafer. It is used primarily for the purposes of planarizing the wafer surface of defining structures. The mechanization process operates to chemically soften (often through oxidation) a shallow layer of the exposed surfaces of the wafer and then remove the softened layer by making sub-microscopic scratches *across* the oxidized surface using the abrasive particles of the slurry. The chemical agent in the slurry modifies only the exposed surfaces of the wafer surface. Only after the abrasive particles have removed the top exposed layer can the oxidizing agent modify the newly exposed wafer material, and the next layer can then be "scratched" away. In essence, he defines this process

as a horizontal process rather than a vertical process.

Boning contends that the CMP process is not an “etch” process. Only the top layer of material is removed in this process. The court has already defined “etch” as “removing material.” Therefore, the process Boning defines is one that removes material. However, the key issue is whether it removes said material by vertical anisotropic etching which is defined as “etching which removes material *significantly faster* in the *vertical* direction than in the *horizontal* direction.” Boning states that CMP is not a vertical anisotropic process. He states that the process actually removes material faster in the horizontal direction than in the vertical direction. CMP continues to remove material across the wafer surface until the process is terminated, as the CMP pad encounters a material that resists removal (a polish stop) which in the case of tungsten is commonly a silicon dioxide layer. He states that there nevertheless may be a residual shallow removal from areas not covered by the polish stop--dishing.

Unless CMP can also remove the adjacent material, CMP cannot effectively remove material from a given point on the wafer surface, which confirms the horizontal nature of CMP. He also states that, in contrast to CMP, vertical anisotropic etching is predominantly carried out in the presence of resistant material. In contrast to CMP, he claims that vertical anisotropic etching also attacks all exposed surfaces regardless of their relative height. Boning also points out that in the accused processes there is an additional step not found in the ‘802 patent. He states that a silicon dioxide insulating layer must be planarized using CMP prior to the etch step in which the contact (or via) openings are formed.

Boning further contends that the accused processes use sputtering as opposed to vacuum evaporation in depositing the interconnection metal. Vacuum evaporation is a method for depositing

a thin film by applying heat to the source of film material, thereby causing evaporation. Sputtering, in contrast, uses a plasma to generate ions which mechanically dislodge particles from the source of the film material. The dislodged particles fly in a line-of-sight fashion to strike and adhere to the wafer surface, in time forming a thin film of the sputtered material. He claims that the two processes are distinct and that the sputtering process cannot infringe Claims 1 and 2. Boning acknowledges that the Court's construction of sputtering would fall within the definition of vacuum evaporation.

Gwozdz states that CMP in a wafer fab is usually arranged as a vertical anisotropic etch, removing material significantly faster in the vertical direction than in the horizontal direction. His assertion that the Tower and UMC processes infringe is primarily based on the testimony of two witnesses, Buchbinder for Tower and Chien for UMC. From this testimony, he constructs charts which he claims support his contention of infringement (Buchbinder at A-2, I, J). Citing Buchbinder's deposition, he claims that the tungsten etching process is done by CMP, which is vertical anisotropic etching. However, Buchbinder merely states that the process is done by CMP.

No question is ever asked of the witness as to whether the process is isotropic or anisotropic. The questioning of the witness sheds no light on the question of vertical or horizontal etching. Apparently Gwozdz is able to make this synapse in reasoning based on his unwavering assertion that half of all fab labs employ CMP, which is, in his opinion, vertical anisotropic etching. STM also states that any "horizontal process" "is really a vertical process" since layering is really etching vertically. Such simplistic reasoning would also mean that any vertical process is also a horizontal process since etching vertically has a layering effect.

Gwozdz apparently discredits the results of the CMP process as demonstrating that there is not literal infringement. The patent teaches that, on vertical anisotropic etching, there is a *uniform*

etching process with the result that the insulating layer is laid *bare* while the contact opening is left practically filled with the conductive material. Claim 1 teaches that the conductive material is *removed* outside the opening. Boning maintains that CMP does not remove all of the material. He argues that recess regions of the wafer are not affected by CMP and hence there is not a uniform removal process across the wafer (Boning at 20).

Gwozdz's Puzzling Statement

Gwozdz steadfastly maintains that CMP is vertical anisotropic etching. However, in his deposition, Gwozdz states that CMP cannot etch the narrow contact opening mentioned in Claim 1 by the preferred method, vertical anisotropic etching. The Court assumes that the question is directed to etching of the insulating layer and not etching of the conductive plug. The patent states that vertical anisotropic etching is the preferred method of etching the contact hole in the insulating layer. Gwozdz's comment that CMP is vertical anisotropic etching leaves the Court with the impression that it is not a true etching process called for by the patent or only an etching process with limited parameters. He does state that CMP can be used for removing the overburdened tungsten. The critical distinction is whether the material is removed *significantly* faster in the vertical rather than the horizontal direction. Although Gwozdz states that such is the case, he does not give any support to his conclusion. "Significant" means "having meaning" or "distinctive." *The New Britannica-Webster Dictionary and Reference Guide*, 856 (1981). STM has belatedly furnished deposition excerpts of Buchbinder's deposition demonstrating that tungsten is removed from the contact hole in the tungsten etch. However, this still does not resolve the issue of whether STM has produced any evidence that CMP removes material significantly faster vertically as opposed to horizontally.

Chien was the designated representative for UMC. The questions and answers given are no model of clarity. When asked whether the tungsten CMP process removed material from within the contact opening, Chien replied: "We hope not, yeah." When later questioned, he stated that it removes material as small as possible. Chien also testified about another process called plasma etch back, which appears to apply to older products. In any event, the depositions of the two witnesses demonstrate that there are still some "holes" in the final analysis of whether CMP is vertical anisotropic etching. If it is not, there is no literal infringement. As to the questioning of both Buchbinder and Chien, the Court is sympathetic to the plight of the court reporter taking Chien's deposition: "What I've got doesn't quite make sense because I'm missing words here and there." The Court is in total agreement. Much of the testimony presented is not helpful on the key issue before the Court.

The Court is left with the task of determining whether there are fact issues as to infringement. The testimony of the various witnesses, as well as Boning and even Gwozdz, indicates that the CMP process produces voids or seams in the conductive material in the contact holes. Sandisk claims that this is contrary to the teaching of the '802 patent. The patent does not mention voids or seams or even indicate that the process is undertaken to avoid such a result. However, the patent does indicate that the *entire volume of the narrow contact openings is filled*. Figure 4 of the patent also indicates that the entire volume of the narrow contact opening has been filled with conductive material. The witnesses for Tower and UMC also indicate that this appears to be an expected consequence of the tungsten process. Gwozdz's assessment is that nothing in claim 1 or 2 of the patent excludes a process that produces seams or voids. The Court finds that, as to voids, there is a fact issue presented.

More troubling is whether STM has sufficiently shown that CMP, as that process is practiced by Tower and UMC, is vertical anisotropic etching. Other than Gwozdz's assertion, the Court can find no support for STM's position. STM maintains that this single unsubstantiated assertion is enough to create a fact issue. Gwozdz states that Buchbinder's deposition by itself explicitly documents all the elements of Claims 1 and 2 demonstrating infringement. Yet, as noted, Buchbinder admits that CMP is used and that a small portion of material is removed from the contact hole in the process. According to STM's lawyers, this is an unintended consequence of the etching process. Yet, no witness confirms that CMP etches significantly faster vertically. Only Gwozdz makes this statement with no support to his assertion. As Boning points out, not all material is removed in the tungsten etch. He states that the process known as dishing demonstrates that the process is not vertical anisotropic etching.

The question for the Court is whether STM has produced any evidence that the CMP process, as practiced by Tower and UMC, fits within the definition of vertical anisotropic etching. To do so, the Court must undertake an analysis of Gwozdz's reasoning. STM attached excerpts of his report. First, he states that probably more than 50% of fabrication processes practice the '802 patent with excess tungsten removed by CMP. Second, he states that CMP parameters are adjusted so that the etch rate, in addition to being sensitive to surface orientation, is also sensitive to local topography, in such a manner that the etch rate at the bottom of small depressions is very *slow*. He states that although conductive material is necessarily removed from the opening due to a rapid vertical etch rate, only a small portion of the conductive material is removed from the opening. This "explanation" adds little to the inquiry of whether CMP actually removes material significantly faster vertically. In fact, his explanation of the slow etch rate at the bottom of small depressions would

seem to detract from a concept of a significantly faster vertical etch rate in CMP.

Boning brings out two differences in CMP and vertical anisotropic etch not addressed by Gwozdz. First, Boning states that vertical anisotropic etch enables engineers to remove material from select portions of the wafer while leaving other portions, those covered by resist, unaffected. As Boning explains, this allows the contact hole to be etched in the first etching process, a process that even Gwozdz admits CMP cannot perform. Second, in contrast to CMP, the vertical anisotropic process attacks all the exposed horizontal wafer surfaces, regardless of their relative height. The process removes both raised and recessed exposed regions of a given material at the same rate and, thus, conserves the differences in height between raised and recessed regions of the wafer surface. Boning points out that Gwozdz's testimony regarding the slow etch rate at bottom of the depressions in CMP demonstrates that the action of CMP is not uniform across all regions of the wafer surface.

Sandisk has also attached articles outlining the Tungsten CMP process (Exh. D to Motion). One article notes that, in the lower areas of the wafer surface, etching is inhibited by the surface film and removal is *slow*, while in the high areas, etching occurs due to the absence of the surface film and the removal rate is *high*.

The Court notes that Gwozdz's rebuttal report does not address any of Boning's opinions or conclusions. Buchbinder and Chien's deposition testimony provides no grounds for Gwozdz's apparent naked assertion that CMP is actually vertical anisotropic etching. Whether material is removed faster vertically or horizontally is never asked. The removal rate features of the process are simply not addressed. The Court has also reviewed Gwozdz's deposition excerpts. Gwozdz gives no underlying rationale to support his conclusion. He claims to have some expertise in CMP as it relates to tungsten plugs. Other than a couple of conclusory statements, he states no facts to support

his position that CMP is vertical anisotropic etching.

STM contends that Gwozdz's statement is enough to preserve a fact issue for resolution in this case. In the end analysis, the void created is in Gwozdz's testimony. There are no substantive facts to back up his conclusory opinion and, as such, STM cannot carry its burden on infringement. *Shaboon v. Duncan*, 252 F.3d 722, 736 (5th Cir. 2001); *Orthopedic & Sports Injury Clinic v. Wang Labs., Inc.*, 922 F.2d 220, 225 (5th Cir. 1991). The Court finds that Sandisk's Motion for Summary Judgment on Noninfringement should be granted.

Doctrine of Equivalents

Sandisk also argues that the doctrine of equivalents does not apply. The doctrine of equivalents holds that, for every claim element not literally present, the accused product must contain an equivalent element. *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17 (1997). Equivalence may be found where the relevant part of the accused product performs the same function in the same way to achieve the same result as the corresponding element in the patent claim. Alternatively, equivalence may also be found where the differences between the relevant part of the accused product and the corresponding element in the patent claim are insubstantial. However, if even one limitation of a claim is not met by an accused device, either literally or by equivalents, there is no infringement as a matter of law. *Lockheed Martine Corp. v. Space Systems/Loral, Inc.*, 324 F.3d 1308, 1321 (Fed. Cir. 2003).

The Federal Circuit has summarized the burden of establishing infringement under the doctrine of equivalents, stating that:

[A] patentee must...provide particularized testimony and linking argument as to the "insubstantiality of the differences" between the claimed invention and the accused device or process, or with respect to the function, way, result test when such evidence

is presented to support a finding of infringement under the doctrine of equivalents. Such evidence must be presented on a limitation-by-limitation basis. Generalized testimony as to the overall similarity between the claims and the accused infringer's product or process will not suffice.

Texas Instruments Inc. v. Cypress Semiconductor Corp. 90 F.3d 1558 (Fed. Cir. 1996). No such testimony is presented by STM.

The Court notes that STM has not pled infringement under the doctrine of equivalents, nor has it briefed the issue in either its response or sur-reply brief. Gwozdz devotes three lines in his report stating, in effect, that Tower and UMC processes infringe under the doctrine of equivalents. He only states that each accused product does substantially the same thing in substantially the same way to achieve substantially the same result, “which [he] understand[s] to be the doctrine of equivalents.” However, it is clear to one, not even an expert, that the alleged infringement is directed to whether the *method* of manufacturing the products infringes, not to whether that the products *per se* infringe. Even if STM had briefed the issue, pled the issue, and submitted evidence on the issue, the doctrine of vitiation would apply.

In this case, the patent requires vertical anisotropic etching of the contact hole. To prevail on its equivalency claim, STM would have to demonstrate that horizontal etching performs substantially the same function as vertical etching. Applying a broad definition of vertical to include horizontal would vitiate the limitation. Therefore, as a matter of law, the doctrine of equivalents cannot apply. *See generally, Nautilus Group, Inc. v. Icon Health & Fitness, Inc.*, 2005 WL 1138653 (W.D. Wash. May 10, 2005). Therefore, the Court finds that STM has waived any complaint of infringement under the doctrine of equivalents, and, even if it was properly raised, STM could present no evidence of infringement.

RECOMMENDATION

Based upon the foregoing, the Court recommends that Sandisk's Motion for Summary Judgment of Noninfringement, or in the Alternative, Invalidity of Claims 1 and 2 of U.S. Patent No. 4,592,802 be GRANTED. The Court further recommends that all other pending motions be DENIED AS MOOT.

Within ten (10) days after filing of the magistrate judge's report, any party may serve and file written objections to the findings and recommendations of the magistrate judge. 28 U.S.C.A. § 636(b)(1)(C).

Failure to file written objections to the proposed findings and recommendations contained in this report within ten days after service shall bar an aggrieved party from *de novo* review by the district court of the proposed findings and recommendations and from appellate review of factual findings accepted or adopted by the district court except on grounds of plain error or manifest injustice. *Thomas v. Arn*, 474 U.S. 140, 148 (1985); *Rodriguez v. Bowen*, 857 F.2d 275, 276-77 (5th Cir. 1988).

SIGNED this 22nd day of June, 2006.



DON D. BUSH
UNITED STATES MAGISTRATE JUDGE